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THE BIOLOGY OF CANADIAN BARKBEETLES.*

INTRODUCTION

BY J. M. SWAINE,

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During the course of an investigation carried out some years ago by the writer in the Gaspé peninsula of Quebec, it was discovered that adults of *Dendroctonus piceaperda* Hopk., *Polygraphus rufipennis* Kby., *Ips perturbatus* Eichh., and *Ips borealis* Sw., cut two sets of tunnels the same season and in some cases hibernated and cut tunnels in the following season. Subsequently, a series of detailed studies on the biology of Canadian barkbeetles has been in progress in field laboratories at Fredericton, N.B., Frater, Ont., Vernon, B.C., and Pender Harbour, B. C.

It has been found that many of our northern species of barkbeetles cut more than one set of tunnels in the same season and that what had previously been considered as a series of generations are in reality, in these cases, a series of broods originated by the same parent adults. Certain species have cut one, two, or three sets of tunnels in different seasons in the same locality; and others have required two years for the completion of their life history at Frater, Ont., whereas the progeny of the same beetles have developed from egg to adult in one year when transferred to the more southerly latitude of Fredericton, N.B. These differences are probably to be explained in part by climatic variations and in part by other conditions, such as the amount of bark available for their use.

In these studies, the infested logs are kept in cages, four or eight feet in length, covered with fine wire or thin cotton cloth or both, fresh logs are supplied in time to accommodate the old parent adults or the young beetles when they emerge to cut new tunnels, and the newly infested logs are then transferred to separate cages.

Larger cages are employed to enclose the entire infested part of the trunk of special trees and others are constructed about portions of the trunk of living standing trees.

The original parent adults of a series are designated A, the progeny from their successive tunnels, a, b, c, etc., and the progeny from the tunnels of the latter in the following manner, in order that the different broods may be referred to without confusion. The progeny of the first brood by a. is designated a.1., the second brood a.2., the third brood a.3., etc.; similarly the first brood by b is designated b.1., etc. The first brood by a.1. is designated a.1.1., the second brood a.1.2., the third a.1.3., etc. The first brood by a.1.2. is designated a.1.2.1., the second brood a.1.2.2., and similarly for the progeny of b and c. The designation a.1.3.2. indicates the second brood (from the second set of tunnels) by a.1.3., which is the third brood (from the third set of tunnels) by a.1., etc.

The progeny from one tunnel or from all the tunnels of the same series,

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such as *a* or *b* or *c*, are referred to as a brood; all the broods from parents in the same series of broods, such as *a* and *b* and *c*, etc., comprise a generation. All the progeny of the hibernated young beetles and larvae will comprise the first generation, whether developed in the first or second year; all the progeny of the broods comprising the first generation will comprise the second generation.

A record of climatic conditions, and other agencies in natural control is being kept in connection with these studies.

It is proposed to publish the results of these biological studies as a series of short papers, of which the following is the first.

THE SEASONAL HISTORY OF *POLYGRAPHUS RUFIPENNIS* KIRBY.

BY L. J. SIMPSON,

Fredericton, N.B.

This species is widely distributed and abundant throughout the spruce forests of Eastern Canada and Northern United States. It is found in spruce, larch, and, less commonly, in pine. It passes the winter in Eastern Canada in all stages, except the egg, within the bark of the stumps, logs and tops of trees cut during the previous spring or summer. The adult beetles emerge in May and June and readily attack stumps, trunks and tops of recently felled trees and trees that have been weakened in vitality by attacks of insects like the spruce budworm and the destructive spruce barkbeetles. Trees being attacked by this species can be readily distinguished by the fine, brownish, boring-dust which is very noticeable in the crevices of the bark. The entrance tunnel is cut by the female and is extended through the outer bark to the inner bark, where a flat nuptial chamber is cut. The female is then joined by a male, who stations himself in the nuptial chamber, from which he pushes out to the exterior the boring-dust that is made by the female in cutting her egg tunnel. He also attempts to exclude any enemies. After the first egg tunnel is started, the male admits two and sometimes three more females and they immediately commence individual egg tunnels. These egg tunnels are cut in the inner bark, radiating from the nuptial chamber.

Polygraphus rufipennis Kirby is a stout, cylindric beetle, clothed with short, stout, scale-like hairs, about 2.5 mm. long, and piceous to black in color. It is easily distinguished from all other barkbeetles of similar size and form by the fact that each of its compound eyes is divided by a smooth, narrow space.

The eggs are pearly-white in color and are laid singly in deep niches on both sides of the egg tunnel, which is from one to two inches long. The eggs are firmly packed in place by fine boring-dust. Hatching begins in about five days and the young larvae immediately commence their mines in the inner bark. When not crowded, the mines are quite regular; but, generally, the infestation is heavy and the mines cross and intercross until the inner bark is almost completely destroyed by them. As soon as the larvae become full-grown, which is, on an average, about twenty-five days after the eggs hatch, each excavates a pupal chamber at the end of the mine and in this transforms to the pupa and finally to the adult.

The pupal stage lasts from seven to ten days, when the new adults begin to appear. These young adults do not emerge during the season in which the eggs were laid, but hibernate in their original tunnels and emerge in May and June of

the following year. Observations made on this species under cage conditions show that one female may cut tunnels and lay eggs for two, three or even four distinct broods extending over one or two seasons.

RECORD OF BROODS

First Brood, 1926 Generation

On June 8, 1926, the young adults of *Polygraphus rufipennis* Kirby, from eggs laid June, 1925, here designated "A" beetles, commenced to emerge from the stick in which they had hibernated through the winter of 1925-26. On June 14, the inside of the cage was swarming with them but only a few had entered the fresh wood which had been provided on May 6. On June 19 all the beetles had entered the bark of the fresh wood, the nuptial chamber had been cut in some cases and the egg tunnels started. On June 26, the egg tunnels had been extended approximately $1\frac{1}{2}$ inches and many eggs had been laid. The first eggs hatched by July 5. The larvae developed rapidly, reaching the pupal stage on August 11, and young beetles were found on August 20. These new beetles (the "a" beetles) hibernated in their original tunnels.

Second Brood, 1926 Generation

On July 23, the parent "A" beetles commenced emerging from the stick in which they had cut their first set of tunnels and cut a second set of tunnels in the fresh wood that had been provided. On July 27, this stick was removed to a separate cage; the beetles by this time having cut their nuptial chamber, commenced their egg tunnels and laid a small number of eggs. The first eggs in these tunnels hatched on June 30, pupation commenced on September 14 and a few new beetles appeared between September 25 and October 22. This brood hibernated as larvae, pupae and young adults ("b" beetles).

Third Brood, 1926 Generation

On August 20, the parent "A" beetles commenced emerging from their second tunnels and commenced their third set in a fresh stick, which, after they were well established, was removed and placed in a separate cage. An September 14, the nuptial chamber was cut, the egg tunnels were well advanced, egg-laying was proceeding, and some eggs were already hatched. This brood hibernated as larvae ("c" beetles). Examinations made on September 25 and October 22 showed the original parent "A" beetles still alive in the egg tunnels of the third brood, and they hibernated in this location during the winter of 1926-27.

Fourth Brood, 1926 Generation

In June, 1927, the original "A" beetles, having hibernated in their third set of tunnels, emerged and cut a fourth set of tunnels in the fresh wood provided. When examined on June 28, the nuptial chamber and much of the egg tunnels had been cut; eggs were found on July 11 and the larvae appeared from July 25 onward, ("d" beetles). The parent adults died in these tunnels.

First Brood, 1927 Generation (by first brood 1926)

The young beetles of the first brood of 1926, designated "a" beetles, hibernated in the bark during the winter of 1926-27, emerged from their tunnels early in June, 1927, and by June 16 they had all entered the bark of the fresh sticks provided. Their first eggs hatched by July 11, the first pupae were found on August 16, and the first young beetles early in September. This brood hibernated as young beetles in their original tunnels, (a.i. beetles).

Second Brood, 1927 Generation (by first brood 1926)

On July 19, the parent "a" beetles emerged from the stick in which they had cut their first set of tunnels and cut a second set in the fresh wood which had been provided, and laid fertile eggs therein. This second brood hibernated as larvae (a.2. beetles) in the winter of 1927-28. The parent "a" beetles hibernated in these tunnels and cut another set of tunnels in the spring of 1928.

Third Brood, 1927 Generation (by first brood 1926)

In June, 1928, the original parent "a" beetles, which had hibernated in their second set of tunnels cut in July, 1927, now designated as "a a" beetles, emerged and commenced a third set. Egg-laying was well advanced by June 25. Small larvae from these eggs were found on July 17. These larvae reached the pupal stage on August 16 and new beetles were abundant in the tunnels on September 6. These new young adults from this brood, designated a.3. beetles, hibernated in their original tunnels throughout the winter of 1928-29 and should emerge in June, 1929, to cut their first tunnels.

The original parent adults, the "aa" beetles, died in their tunnels.

First Brood, 1928 Generation (by second brood 1927)

These young adults, designated a.2. beetles, are the progeny of the second brood of eggs laid by the original "a" beetles in July, 1927. The larvae from these eggs hibernated throughout the winter of 1927-28, developed to new adults during the season of 1928, hibernated as young adult beetles in their original tunnels during the winter of 1928-29 and will emerge in June, 1929, to cut their first tunnels, (a.2.1.).

First Brood, 1927 Generation (by second brood 1926)

The young beetles of the second brood of 1926, designated "b" beetles, hibernated in the bark during the winter of 1926-27 and emerged from their tunnels early in June, 1927; by July 5 they had all entered the bark of the fresh sticks provided. The first eggs hatched on July 19, the first pupae appeared by August 23 and the first young beetles the middle of September. This brood hibernated as young beetles in their original tunnels, (b.1. beetles).

Second Brood, 1927 Generation (by second brood 1926)

On August 23, the parent "b" beetles emerged from the stick in which they had cut their first set of tunnels and cut a second set in the fresh wood which had been provided, and laid fertile eggs therein. This second brood hibernated as larvae in the winter of 1927-28, (b.2. beetles). The parent "b" beetles died in these tunnels.

First Brood 1927 Generation (by third brood 1926)

These young adults, designated "c" beetles, are the progeny of the original "A" beetles, the eggs having been laid in September, 1926. The larvae from these eggs hibernated throughout the winter of 1926-27, developed to new adults during the season of 1927, hibernated as young adult beetles in their original tunnels during the winter of 1927-28, (c) emerged in June, 1928, and commenced their first tunnels in the fresh log provided. On June 8, their entrance hole and nuptial chamber had been completed, much of the egg tunnel had been cut and numerous eggs laid by June 15. Larvae from these eggs were found in abundance by July 4. Pupae were found on August 16 and new adults from this brood appeared on August 23. This brood, designated c.1. beetles, is hibernating as young

adults in their original tunnels and should emerge in June, 1929, to cut their first set of tunnels.

Second Brood, 1927 Generation (by third brood 1926)

On July 9, 1928, the parent "c" beetles emerged from the stick in which they had cut their first set of tunnels and cut a second set in the bark of the fresh wood provided. Egg-laying in these tunnels was well advanced by July 25; the larvae from these eggs developed to pupae by September 6 and new beetles were found on September 20. This brood, designated c.2. beetles, hibernated as pupae and new adults in their original tunnels.

The parent adult, "c," beetles hibernated in their second tunnels and may emerge in June, 1929, to cut a third set.

First Brood, 1928 Generation (by the first brood 1927)

The young beetles of the first brood in 1927, designated a.1. beetles, hibernated in the bark during the winter of 1927-28, emerged from their tunnels early in June, 1928, and by June 15 had completed their entrance holes, formed their nuptial chamber and were extending their egg tunnels and laying eggs. Larvae were found hatched from these eggs on July 4, which developed and commenced to pupate on August 16, and new adult beetles were found on August 31. This brood hibernated as adults in their original tunnels, (a.1.1. beetles).

Second Brood, 1928 Generation (by first brood 1927)

On July 4, the parent a.1. beetles emerged from the log in which they had cut their first set of tunnels and commenced a second set in the fresh wood provided, and laid a second brood of eggs. The larvae from these eggs developed and hibernated as such in their original tunnels through the winter of 1928-29, a.1.2. The parent a.1. beetles also hibernated in these tunnels and will probably cut another set in the spring of 1929.

First Brood, 1928 Generation (by first brood, 1927, by second brood, 1926)

The young adult b.1. beetles are the progeny of the first brood of eggs laid in June, 1927, by the "b" beetles which were the progeny of the second brood of July, 1926, laid by the original "A" beetles.

In June, 1928, the young b.1. beetles commenced their first set of tunnels. Egg-laying was completed in this set on July 4. The larvae from these eggs transformed to adults by August 31 and hibernated in their original tunnels during the winter of 1928-29, (b.1.1. beetles).

Second Brood, 1928 Generation (by first brood, 1927, by second brood, 1926)

On July 4, the parent b.1. beetles emerged from their first egg tunnels and cut a second set in the fresh wood provided and laid fertile eggs therein. This second brood, designated b.1.2. beetles, hibernated as larvae in the winter of 1928-29. The parent b.1. beetles were alive in these tunnels when last examined on September 28 and will probably cut another set of tunnels in the spring of 1929.

The seasons of 1925 and 1926 varied little from the normal with reference to temperature and humidity. During these two seasons the adults of *Polygraphus rufipennis* Kirby cut three sets of egg tunnels and laid three broods of eggs, hibernated in their third set of egg tunnels, emerged the following June, cut a fourth set of tunnels and laid a fourth brood of eggs therein.

The climatic conditions of 1927 were decidedly abnormal. The spring and early summer were very cold and wet, and these conditions generally continued throughout the season.

Polygraphus rufipennis Ky.

1925

Parent beetles; date of origin	Egg tunnels	Date of attack	History of progeny	Designation of brood
Hibernated old beetles	1st tunnels	June 1925	Progeny hibernated as young adults	A
	2nd tunnels	July 1925	Progeny hibernated as larvae, pupae and young adults	B
	3rd tunnels	August 1925	Progeny hibernated as larvae	C

(B and C Broods dropped)

1926

A beetles young adults of June, 1925	1st tunnels	June 1926	Progeny hibernated as young adults to em- erge June, 1927	a
	2nd tunnels	July 1926	Progeny hibernated as larvae, pupae and young adults to em- erge July, 1927	b
	3rd tunnels	September 1926	Progeny hibernated as larvae to emerge June, 1928 Parent adults hibernated in third set of tunnels winter 1926-27.	c

1927

Hibernated A beetles June, 1925	4th tunnels	June 1927	Brood died; parent adults died in 4th set of tunnels	d
a beetles, young adults June, 1926	1st tunnels	June 1927	Progeny hibernated as young adults to emerge June, 1928	a1
	2nd tunnels	July 1927	Progeny hibernated as larvae Parent adults hibernated in second set of tunnels	a2
b beetles, young adults July, 1926	1st tunnels	June 1927	Progeny hibernated as young adults, to em- erge June, 1928	b1
	2nd tunnels	July 1927	Progeny hibernated as larvae; parent 'b' beet- les and brood died in winter through fungus	b2

1928

Parent beetles; date of origin	Egg tunnels	Date of attack	History of progeny	Designation of brood
c beetles, young adults, September, 1926	1st tunnels	June 1928	Progeny hibernated as young adults, to emerge in June, 1929.	c1
	2nd tunnels	July 1928	Progeny hibernated as pupae and young adults, to emerge in June, 1929.	c2
			Parent adults hibernated in second tunnels, winter 1928-29.	
Hibernated a beetles young adults June, 1926	3rd tunnels	June 1928	Progeny hibernated as young adults, to emerge June, 1929.	a.3
a1 beetles, young adults June, 1927	1st tunnels	June 1928	Progeny hibernated as young adults, to emerge June, 1929.	a.1.1.
	2nd tunnels	July 1928	Hibernated as larvae, to emerge June, 1930.	a.1.2.
			Parent adults hibernated in second tunnels, winter 1928-29.	
a2 beetles developed to young adults during season of 1928			Hibernated in original tun- nels to emerge June, 1929.	a.2
b1 beetles, young adults from June, 1927	1st tunnels	June 1928	Progeny hibernated as young adults to emerge June, 1929.	b.1.1.
	2nd tunnels	July 1928	Hibernated as larvae to emerge June, 1930.	b.1.2
			Parent adults hibernated in second set of tunnels.	

ON SOME FALSE SCORPIONS OF THE SUBORDER HETEROSPHYRONIDA (ARACHNIDA-CHELONETHIDA).

BY JOSEPH CONRAD CHAMBERLIN,
Stanford University.

The following contribution is supplementary and complementary to a more extensive paper recently published in the *Annals and Magazine of Natural History*.^{*} An elucidation of the terminology and definitions of the higher categories employed may be found therein.

Suborder HETEROSPHYRONIDA J. C. Chamberlin

Family CHTHONIIDAE Hansen

Subfamily DITHINAE J. C. Chamberlin

Tribe DITHINI J. C. Chamberlin

Compsaditha javana sp. nov.

Holotype. ♀, (JC-321.01001), labeled "Banjoewangi Java. 1911. MacGillivry." Collection of Dr. A. C. Oudemans of Holland to whom I am indebted for the loan of the only known specimen.

Diagnosis. Coxal spines as in *pygmaea* except that they are equally pinnate instead of merely distally incised; femur of palpus 3.2 times as long as broad; tibia 1.8 times as long as broad; chela 4.1 times as long as broad; movable finger 0.68 total length of chela. Length 1.0 mm.

Remarks. Interesting in that it extends the range of the genus to Java. It has been previously recorded only from the Philippines. The species is distinctly more robust than *pygmaea*.

Subfamily CHTHONIINAE Daday.

Tribe KEWOCHTHONINI J. C. Chamberlin.

Mundochthonius japonicus sp. nov.

Holotype. ♀, (JC-390.03001). Mt. Kirishima, Japan. Collected by Dr. F. Silvestri, September 20, 1924. No material other than holotype known.

Diagnosis. Tergal chaetotaxy 4:4:4:6:6:6:6. Sternites with 8-10 marginal setae; coxal spine about twice as long as basal width and with both lateral and terminal incisions; rather more similar so far as coxal spine is concerned, to *magnus* than *erosidens* or *montanus*. The following proportions are from KOH-treated material. Carapace 1.3 to 1.4 times as long as chelicerae; femur 3.2 times as long as broad; proportions of tibia not ascertainable because of injury; chela 4 times as long as broad. Length 0.9 mm.

Remarks. This is the first member of this genus to be discovered outside the territorial limits of the United States. The holotype is possibly somewhat immature.

Genus APOCHTHONIUS J. C. Chamberlin

Remarks. In the original description of this genus it was not noted that the marginal teeth of the chela are differentiated into two sizes, larger ones alternating with two or more smaller ones. This differentiation is not conspicuous but is nonetheless readily observable. The discovery of a species with the characteristic coxal spines of this genus with a chela bearing clearly spaced marginal

^{*}—Joseph C. Chamberlin. "A Synoptic Classification of the False Scorpions. Part I. The Heterosphyronida. *Annals and Magazine of Natural History*, London, (Early in 1930).

teeth indicates an intergradation between the two tribes previously recognized in this subfamily. Two subgenera belonging to the present group are here recognized. They may be separated by means of the following couplet.

KEY TO THE SUBGENERA OF APOCHTHONIUS

Marginal teeth of chela clearly spaced anteriorly *Heterochthonius* subgenus novus.
Marginal teeth of chela contiguous throughout ... *Apochthonius* subgenus typicus.

***Apochthonius (Apochthonius) moestus* (Banks)**

Material examined. A collection of 35 specimens (JC-432.01001-33 and 3.01001-2) including male, female and immature forms. Collected Dec. 27 (year unknown), by Dr. R. V. Chamberlin at Falls Church, Virginia.

***Apochthonius (Apochthonius) intermedius* sp. nov.**

Holotype. ♂, (JC-443.01001); *Allotype*, ♀, (JC-443.03001). Friday Harbor, San Juan Island, state of Washington. In moss, on ground; Douglas fir forest.

Paratypes: ♂ and ♀ (JC-443.03003-3) and ♀, (JC-443.04001), same locality and habitat as holotype and allotype. ♀, (JC-440.01001), same locality as preceding material but in dead leaf litter in stand of *Alnus oregona*. All material collected during June and July of 1928 by Prof. Martha W. Shackleford. My thanks are due Prof. Shackleford for the privilege of studying this material.

Diagnosis. More or less "intermediate" between *moestus* and *occidentalis*. Male genitalia much more similar to that of *moestus* than *occidentalis*; chaetotaxy of male genital operculum the same as in *occidentalis*, clearly less hairy than *moestus* (genital opening itself bordered by about 14 setae as compared with 18 in *moestus*; border setae flanked on either side by a group of about 4 setae as compared with 6 or 7 in *moestus*). Palps clearly more robust than those of *occidentalis* whose range it apparently shares. Trochanter 1.6 to 1.7 times as long as broad; femur 4.3 to 4.4 times as long as broad; tibia 1.5 to 1.7 times as long as broad; chela 4.1 to 4.3 times as long as broad; fingers almost twice as long as hand and 0.68 total length of chela. Length 1.5 mm.

***Heterochthonius* subgenus novus.**

Orthotype. *Apochthonius (Heterochthonius) crosbyi* sp. nov.

Diagnosis. The characters are essentially the same as those of *Apochthonius* proper, except for the anomalous fact that the marginal teeth of the chela are clearly spaced, a character which of itself would throw the included species outside of the present tribe and into the Chthonini. There is practically no doubt, however, that the orthotype (and only known species) of the group is closely related to *Apochthonius*. A revision of the tribal characters of this subfamily (the Chthoniinae) will no doubt ultimately be necessary.

***Apochthonius (Heterochthonius) crosbyi* sp. nov.**

Holotype. ♂, (JC-318.01001). From summit of Mt. Mitchell, North Carolina, U.S.A. In company with *Neobisium carolinensis* (Banks). Coll. Oct. 22, 1923 by Dr. C. R. Crosby to whom the species is dedicated.

Diagnosis. Carapace smoothly truncate, without median anterior prolongation; somewhat longer than broad, broadest across eyes; carapacial chaetotaxy 10-4, (24). Tergal chaetotaxy: 4:4:7:7:7:9:9:10. Median sternites with about 12 border setae. Femur 3.8 times as long as broad; tibial proportions not ascertainable from specimen at hand; chela (doubtful, due to mutilation) 3.9

times as long as greatest breadth; fingers 0.72 total length of chela. Length of male, 1.5 mm.

Tribe CHTHONINI J. C. Chamberlin.

Genus PSUDOCHTHONIUS Balzan.

Remarks. Through the courtesy of Mons. Louis Fage of the Museum of Natural History in Paris, I have had the opportunity of examining a specimen of *Pseudochthonius simoni* Balzan, the orthotype of the present genus. This makes it possible to record certain important data of generic significance not hitherto available.

Generic characters. Heterodigitate, the movable finger of the chela much the shortest, extending about even with E.T. Heterodentate, large and small teeth which are widely spaced, alternating with each other on fixed finger; marginal teeth of movable finger low and wedge-shaped, apices posterior and widely separated but contiguous at base. Spinneret present as a sclerotic knob; palm of chelicera with 5 setae. Intercoxal tubercle apparently truly absent. Coxal spines present on coxae I and II, consisting of a series of obliquely oriented, contiguous lobes each of which bears a unilaterally pinnate blade.

Pseudochthonius simoni (Balzan).

Material examined. ♀, (JC-448.01001). Labeled "Type." "Caracas." (Venezuela). Loaned through the courtesy of Dr. Louis Fage to whom I wish to extend my sincerest thanks.

Remarks. The coxal spines of this species, while less specialized, are quite reminiscent of those found in *Tyrannochthonius johnstoni* (J. C. Chamberlin).

Chthonius tetrachelatus (Prevssler).

Material examined. 2♂, (IC-433.01001-2). (Fall Creek), Ithaca, New York. Coll. May 18 (year unknown) by Dr. R. V. Chamberlin.

Chthonius californicus J. C. Chamberlin.

Material examined. ♀, (JC-323.01001) from debris under Monterey Cypress trees, near beach at Half Moon Bay, San Mateo County, California. Collected by Dr. P. N. Annand. The specimen is quite typical.

Genus *Allochthonius* novus.

Orthotype. Chthonius opticus Ellingsen.

Diagnosis. Homodentate; marginal teeth well-spaced and prominent; bi-setose intercoxal tubercle present, strongly developed and expanded to form a minute but true sternum; coxal spines present on I only, consisting of a tubercle expanded terminally into a characteristic "spray" or "fan" of about eight clavate processes which extend anteriorly and more or less shield the apical process of coxa I; with four well-developed eyes; spinneret completely absent.

Distribution. Japanese. Known from the genotype from the Island of Hondo and *shintoisiticus* sp. nov. from the island of Kyushu.

Remarks. It is possible that the species here termed *shintoisiticus* is identical with *opticus* but in view of the fact that Ellingsen's description is incomplete in certain important respects and that certain differences between my material and Ellingsen's description are quite apparent it seems best to maintain them as distinct, at least until a re-examination of Ellingsen's material can be made. The following couplet summarizes the apparent differences.

Eyes scarcely a diameter from each other; anterior pair of eyes one diameter from

the anterior margin of the carapace; femur 4.5 times as long as breadth; fixed finger of chelicera with a large basal tooth preceded anteriorly by a number of distinctly smaller teeth of approximately uniform size; movable finger of chelicera with "some minute teeth on central part" *opticus* (Ellingsen). Eyes clearly much less than an ocular diameter apart—almost contiguous; anterior pair of eyes 1 and $1/3$ diameters from the anterior margin of the carapace; femur 5.0 times as long as broad; fixed finger of chelicera with a large basal and a large sub-apical tooth between which lie 2 or 3 uniformly sized but clearly smaller teeth; movable finger with 18-20 small saw-like teeth *shintoisticus* sp. nov.

***Allochthonius opticus* (Ellingsen).**

1906—*Chthonius opticus* Ellingsen. *Nyt. Mag. for Naturvidenskab. (Christiania)* p. 17. (1907).

Remarks. Although Ellingsen does not note its presence, there is little doubt as to the presence of the intercoxal tubercle. As described by Ellingsen the coxal tubercle is quite like the one observed on *shintoisticus*. On no other grounds than this I would not hesitate to regard them as congeneric.

***Allochthonius shintoisticus* sp. nov.**

Holotype. ♀, (JC-372.01001). *Paratype*, ♀, (JC-372.01002). Collected by Dr. F. Silvestri at Unzen, Kyushu, Japan; May 24, 1925.

Diagnosis. Carapace without epistomal process, slightly broader than long and distinctly constricted posteriorly; chaetotaxy 8-4, (24). Tergal chaetotaxy 4:6:7:7:8:9:9. Sternites with about 14-15 marginal setae. Fixed finger of chela with 18 teeth; movable finger with 15. Femur 5.1 times as long as broad; fingers 0.69 total length of chela; other palpal proportions not ascertainable because of mutilation (due to shrinkage and collapse of parts). Length 2.2 mm.

NOTES ON THE GENUS *PHILAEUS* IN AMERICA NORTH OF MEXICO, (HOMOP., CERCOPIDAE).*

BY G. STUART WALLEY,

Ottawa, Ont.

Ball's treatment of the genus *Philaenus* (Proc. Ia. Acad. Sci., VI, pp. 223-226, 1898) contains a discussion of two species. Subsequently a third species described by Stearns (Ent. News, XXIX, 3, 1918) has been added and the genus reviewed by Stearns (Conn. St. Geol. Nat. Hist. Surv. Bul. 34, pt. IV, pp. 224-227, 1923). The present paper includes the description of a new Canadian species with a key to species and varieties based on material represented in the Canadian National Collection.

The four species treated herein are readily separable by the following key. Three of the species appear quite constant in regard to color patterns. *P. leucophthalmus* (Linn.) however possesses a wide range of color varieties varying from pale yellow to entirely black. Many of these varieties are so pronounced as to have lead a number of the earlier authors to treat them as distinct species. More recent writers including Melichar (Cicad. Mitt. Eur., 122, 1896), Ball (loc. cit.) and Stearns (loc. cit.) recognizing the structural identity of all the varieties and the occurrence of certain color intergradients, have assigned them to varietal rank. From a study of a large series of specimens ranging from the Atlantic to the Pacific the writer has found that almost all of the specimens may be readily assigned to one or another of the varieties given in the following key.

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

TABLE OF SPECIES AND VARIETIES OF PHILAEENUS.

1. Hind wing with third vein from margin for 3d at apex; costal margin of elytron convex 3.
Hind wing with third vein from margin not forked; costal margin of elytron almost straight 2.
2. Length 8 mm. or more; pale yellow with conspicuous dark brown stripe from anterior margin of tylus across vertex and pronotum and along elytral suture to apex *parallelus* Stearns.
Length not exceeding 6.5 mm.; pale yellow without a conspicuous dark brown stripe *lineatus* (Linn.).
3. Vertex twice as wide as long; length of tylus distinctly more than half length of vertex 4.
Vertex one-third wider than long; length of tylus sub-equal to half length of vertex *canadensis* n. sp.
4. Elytra dark brown or black, occasionally with obscure yellowish flecks but the costal margin never broadly pale nor with two pale spots 5.
Elytra in part or wholly pale, costal margin often broadly pale or with two pale spots 6.
5. Vertex and pronotum dark brown or black, rarely with traces of yellow *leucophthalmus* (Linn.).
Vertex and anterior half of pronotum yellow *leucophthalmus* var. *leucocephalus* (Linn.).
6. Vertex pronotum and elytra uniformly pale yellowish *leucophthalmus* var. *pallidus* (Zett.).
Vertex, pronotum and elytra not uniformly pale yellowish 7.
7. Costal margin of elytra with one or two pale areas but these do not form a continuous stripe along margin 10.
Costal margin with an uninterrupted pale stripe 8.
8. Elytra dark brown except for pale costal stripe 9.
Elytra with broad sutural yellowish stripe; inner margins of elytra and middle of corium with a brownish stripe *leucophthalmus* var. *fabricii* Van D.
9. Vertex and anterior half of pronotum pale *leucophthalmus* var. *marginellus* (Fabr.).
Vertex and entire pronotum dark brown or black *leucophthalmus* var. *lateralis* (Linn.).
10. Vertex and anterior half of pronotum golden yellow; elytra brown with two white spots on costal margin *leucophthalmus* var. *fasciatus* (Fabr.).
Vertex and anterior half of pronotum brownish yellow; elytra tawny yellow with two yellowish white spots on costal margin *leucophthalmus* var. *ustulatus* (Fabr.).

***Philaenus canadensis* n. sp.**

Male. Length 6 mm.; width 2.75 mm. Vertex (not including eyes) wider than long; disk virtually flat, slightly more horizontal than pronotum. Tylus very slightly more than one-half median length of vertex and with a very fine median carinule. Margins of vertex between eyes and tylus straight and if produced would meet at a right angle; tylus not exerted but rather evenly rounded, its posterior margin straight. Ocelli near posterior margin of vertex, inter-ocellar

width sub-equal to half distance between ocellus and posterior margin of tylus. Front slightly more inflated and hence more obtusely angulate than in *P. parallelus* Stearns.

Pronotum evenly and weakly convex, without median carina; anterior margin broadly rounded; lateral margins short, equalling distance between ocelli, diverging posteriorly; posterior margin deeply emarginate. Pronotum evenly and rather closely punctate, the punctures distinct and each bearing an appressed pale yellow hair. Scutellum more finely and densely punctate than pronotum.

Elytron two-fifths as broad as long, outer margin dilated and sinuous on basal half, closely punctate, the punctures becoming shallower and less distinct apically. Hind wing with third vein from costal margin forked at apex.

Genitalia with basal half of ventral plates proportionately broader than in *P. lineatus* Linn., somewhat as in *P. parallelus* Stearns but with apical one-fourth much narrower than in *parallelus*.

Color.—Vertex, pronotum and elytra dark brown the latter with an obscure sub-hyaline area on costa before middle; evenly clothed with short appressed yellowish white pubescence. Front dirty yellow, a broad black stripe extending across front below margin of vertex between eyes. Legs blackish brown with knees paler; hind legs, especially coxae, paler brown than anterior legs. Metasternum yellowish brown. Abdomen and genital plate dark blackish brown.

Holotype.—♂, Port Bruce, Ontario, July 4, 1926 (G. S. Walley), No. 2952 in the Canadian National Collection, Ottawa.

Allotype.—♀, Orillia, Ontario, June 5, 1925 (C. H. Curran).

The allotype agrees in general form and color with the holotype but is slightly larger (7 mm. long) and has the front darkened almost to the lower margin.

NOTES ON THE ASILID GENERA *BOMBOMIMA* AND *LAPHRIA* WITH DESCRIPTIONS OF THREE NEW SPECIES AND TWO NEW VARIETIES (DIPTERA).

BY S. W. BROMLEY,

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The collection from which this study was made was obtained through the courtesy of the Entomological Branch, Canadian Department of Agriculture, and was of particular interest in that it not only contained excellent series of many of the described forms but also several undescribed species. Descriptions of the latter are submitted in the present paper together with notes on some of the others.

The species placed in the genus *Bombomima* Enderlein comprise those which have hitherto been placed by American authors in the genus *Dasyllis* Loew. Attention has been called by Bezzi, Hermann and Yerbury (cited by Williston) to the fact that our North American species are entirely distinct generically from the South American *Dasyllis*, the typical species of which is *haemorrhoea* Wiedemann. Two other species, *fascipennis* Macquart and *croceiventris* Wiedemann are known. These species are quite unlike our North American species, being more nearly related to the old World genus *Hyperechia* Schiner and their clos-

est affinities in this country are with *Andrenosoma*. *Bombomima*, the typical species of which is *B. thoracica* Fabricius is closely related to *Laphria* from which some of the species may be separated only with difficulty. The robust, bumble-bee like appearance, the broader abdomen, the large rounded thickly pilose mesonotum, and the short, stout, thickly hairy legs should serve to distinguish the species from the closely related genus *Laphria*.

Bombomima flavicollis Say. A single male from Vancouver, B.C., (July 1921, Osburn Coll. No. 43) represents the most western record of this common eastern form. It differs slightly in having more yellow hair on the genitalia and legs than is usually the case in the eastern specimens. There is, however, a question as to whether the specimen is correctly labelled.

Bombomima vorax new species

Length: 20 mm., exclusive of proboscis. Related to *B. fernaldi* Back from which it may be distinguished by the 6th abdominal tergite with only black hairs, the larger and stronger proboscis, and the larger and stouter genitalia which are entirely black with black hairs. In *fernaldi* the genitalia may be somewhat brownish with yellow and orange hairs.

Vorax is to be distinguished from *posticata* Say by the presence of yellowish hairs in front of the wings, instead of black; its larger size; proportionately longer and more slender abdomen; and the presence of orange colored hairs on the 4th and 5th tergites. It also differs from *posticata* in that it lacks the prominent tuft of yellow hairs on each side of the third tergite.

Male. Head black, the proboscis large and stout, widening slightly in profile before the tip. Mystax, hairs of the face, a few hairs on 1st antennal segment, beard and post-genal hairs brassy yellow. Palpal hairs, part of the antennal bristles, hairs of vertex, occipital hairs and bristles, black. Thorax black, pronotal bristles black; hairs on anterior border of mesonotum, black. Hairs of mesonotum, coxae, tuft of hairs in front of halteres and in front of wings, brassy yellow. Legs black, pulvilli pale brown. Most of hairs on legs black. The anterior and middle tibiae are quite thickly set with yellowish hairs. Wings light brownish-gray with reddish veins. Halteres pale yellowish brown. Abdomen black. First three segments with mostly black hairs, but there are a few yellowish hairs on the posterior lateral margins. 4th and 5th tergites thickly covered with short, closely appressed yellowish hairs, intermingled with reddish-orange hairs. The latter are absent on the sides but make up most of the vestiture of the median dorsal area. 6th tergite with only black hairs. Genitalia large, black, with black hairs.

Female. Similar but with fewer yellow hairs on the anterior and middle tibiae. The ovipositor is black with black hairs except the very tip which bears a very few yellowish hairs.

Holotype. ♂, Montgomery County, Ks. (798 ft. elevation) 1916. Collected by R. H. Beamer.

Allotype, ♀, Nebraska, in American Museum Collection, No. 5090. (W. M. Wheeler).

Paratypes, 2 ♂, Nebraska, in American Museum Collection, Nos. 5091 and 5092 (W. M. Wheeler); 1 ♀, Montgomery County, Ks., (798 ft. elevation) 1916.

Bombomima huron new species.

Length: 15-20 mm., exclusive of proboscis. Most nearly related to *sacra-tor* Walker, from which it may be distinguished by the black hairs on the 1st 3 abdominal segments, and the greater amount of black hairs in the mystax. In *sacra-tor* the 1st 3 tergites are thickly covered with yellow pile. From *thoracica* Fabr. it may be distinguished by the thick yellow pile on the anterior and middle tibiae, the more slender abdomen, narrower thorax, and generally less robust appearance. The forceps are narrower and more prolonged than in *thoracica* and bear a small tuft of yellowish hair at the sides. In *thoracica* the hairs of the genitalia are all black. Distinguished from *affinis* Macquart, by the black beard, the tuft of hairs in front of wings being yellow and the hairs of the scutellum being yellow.

Male. Head black, vestiture all black except a few hairs on face and in mystax yellow. Pronotal bristles black. Thoracic vestiture, including that of scutellum and postscutellum, pleura, mesonotum, tuft in front of wings and halteres, yellow. A few black hairs on coxae and a few black bristles on mesonotum at base of wing. Legs black with black hairs, the exterior portion of the front femora and tibiae, the apex of the middle femora and exterior portion of middle tibiae, thickly clothed with yellow hairs. Apex of posterior femora and basal extremity of posterior tibiae with a few yellow hairs. Tarsi with black bristles but clothed thickly with minute ferruginous hairs. Pulvilli light brown. Claws black, pale brown at base. Wings pale grayish, nearly hyaline, tinged slightly with brownish along veins. Halteres pale brown. Abdomen black with black hairs, rather narrow. A tuft of yellowish hairs on each side of the 2nd segment. Genitalia black with black hairs except a small tuft of yellowish or brownish hairs on the sides of the forceps.

Female. Similar. Abdomen slightly broader and tuft of yellow hairs on sides of second abdominal tergite small and more inconspicuous. Tip of ovipositor with a few yellowish hairs.

In one male, the yellow vestiture has a brownish tinge.

Holotype, ♂, Camp 33, Ontario, Lake Abitibi, Canada, July 6, 1925. (N. K. Bigelow.).

Allotopotype, ♀, July 7, 1925 (N. K. Bigelow).

Paratypes, 2♂, St. Andrews, N. B. July 15, 1922 (E. M. Walker).
Ottawa, Canada, July 12. (Harrington).

Bombomima posticata, var. *brunnea*, var. nov.

A race of *posticata* from Ontario and Manitoba has the light vestiture brown instead of yellow and the ground color of the abdomen somewhat metallic bluish, otherwise the specimens agree with *posticata*. Some of the hairs on the scutellum may be brownish.

Holotype, ♂, Macdiarmid, Lake Nipigon, Ontario, Aug. 24, 1923 (N. K. Bigelow).

Paratypes, ♂♂, Victoria Beach, Manitoba, July 22, 1923, and two, July 22, 1922; (G. S. Brooks).

B. posticata var. *scutellaris* var. nov.

A race of *posticata* with the vestiture more yellowish than the above but in

general with a more brownish tinge than the typical form. The scutellum has the bristles yellowish instead of black.

Holotype ♂, Sudbury, Ontario, Canada, July 7, 1889.

Paratypes, ♂♂, Three others from Sudbury, Ont. July 7, 1889; Fairy Lake, Quebec, June 15, 1923 (R. Ozburn); Lake Nipigon July 1, 1882 (James Fletcher); a ♂ and ♀ on same pin from Aylmer, Quebec, July 24, 1924 (C. H. Curran).

Bombomima fernaldi Back. This widely distributed species shows considerable variation in the distribution of yellow pile, both on the thorax and on the abdomen. In some individuals the mesonotum may be almost completely yellow-haired; in others the anterior portion may bear a considerable proportion of black hairs. The tuft of hair in front of the wings varies from pure yellow to pure black. The fourth segment of the abdomen, however, always bears reddish hairs, the hairs of the genitalia are yellow, and the sixth segment always bears light colored hairs.

Laphria milvina new species.

Length 14-18 mm., (exclusive of proboscis). Related to *vultur* Osten Sacken from which it may be distinguished by its much smaller size, and black hairs of mystax, vertex, occiput and mesonotum. The hairs of legs are all black also.

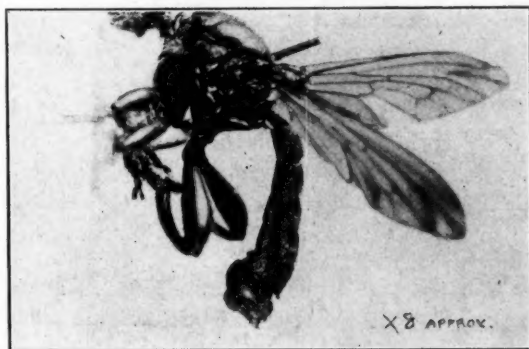
Female. Head black. Mystax, hairs of antennae, vertex and occiput black. Beard reddish golden, a few hairs in mystax and the hairs of the face are of the same color. Pronotal bristles black. Mesonotum deep metallic blue black thinly covered with short fine erect black hairs, a few brownish yellow hairs on posterior border. Scutellum with light brownish yellow hairs and bristles. Humeral callus and pleura with reddish gold vestiture. Coxae with both black and reddish gold hairs. Legs black with black hairs. A patch of minute golden hairs on inner side of front tibiae. Wings light grayish brown, hyaline at base. Halteres pale reddish brown. Abdomen stout, black, thickly clothed with reddish-golden pile. Vestiture rather scanty on median dorsal area of 1st two segments where there are some fine black hairs. Ovipositor with a few black and some golden hairs.

Holotype, ♀, Revelstoke Mt. B.C. Elevation 6000 ft. Aug. 12, 1923 (P. N. Vroom).

Paratype ♀, Aspen Grove, B.C., July 1, 1923. (E. R. Buckell).

Laphria aeatus Walker. A male (July 20, 1924) and a female (June 30, 1924) from Lesser Slave Lake, Alberta. This species has, heretofore, been confused with several other North American species. In general the name *aeatus* was applied most frequently to *L. index* McAtee or to *L. scorpio* McAtee, although McAtee in his study of this genus (Ohio Journal of Science XIX, No. 2, Dec. 1918 p. 161) stated that in the collections studied by him no fewer than 5 different species were found wrongly labelled as *aeatus*. McAtee suggested the possibility of his species *aimatis* being identical with *aeatus* but the difference in size and the different geographical distribution did not encourage the identification of the two. Johnson in the Diptera of New England (Boston Soc. Nat. Hist. VII Fauna of N.E. 15 p. 118, 1925) reduced *index* McAtee to synonymy with *aeatus* Walker. In order to definitely identify *aeatus*, the writer sent a specimen

of *index* McAtee to the British Museum for comparison with Walker's type after Major Austen had kindly agreed to make comparisons. The specimen arrived while Mr. McAtee was visiting the museum and their joint examination showed the two species to be definitely distinct. Major Austen reported that two different species were included in the type material of *aeatus*. The holotype, a male, is from St. Martins Falls, Albany River, Hudson's Bay while specimen *b*, recorded by Walker from Nova Scotia (Lieut. Redwan's collection), is a distinct species, as yet unidentified. Major Austen arranged for a photograph of the type to be taken and transmitted to the writer. This photograph is herewith reproduced.



Aeatus Walker is to be distinguished from related species by the presence of a pair of hook-like processes on the median posterior margin of the 6th tergite in the male. This character may be readily discerned in the accompanying photograph. Mention of this character was not made in Walker's description which otherwise fits the specimen under consideration. The ground color of the abdomen is, however, black and not ferruginous.

The two specimens from Lesser Slave Lake measure ♂ 13 mm. and ♀ 16 mm., respectively. The pile on the abdomen is scanty on the 1st two segments but is quite dense on the following segments and is bright reddish-golden. In *scorpio* McAtee, to which the species is probably most closely related, the pile is more yellowish lacking the reddish hue. There is very little light pile on the thoracic dorsum and what there is is whitish or very pale yellowish. The scutellum bears a few whitish hairs but the marginal bristles are black.

NEW CANADIAN ANTHOMYIDS BELONGING TO THE GENUS
HYLEMYIA ROB-DESV. (MUSCIDAE, DIPTERA).

BY H. C. HUCKETT,

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(Continued from page 144)

***Hylemyia frontulenta* sp. nov.**

This species is very closely related to the following, differing only in a few respects from its description. The male has a small antenna, the third segment 1.25 times length of second. The vibrissae are more closely approximated,

being separated by a distance about equal to length of third antennal segment. The prealar bristle is shorter than posterior notopleural bristle. The processes of fifth sternum are not glossy along inner margin. The mid tibia has no anterior bristle, and the hind femur has a proximal series of short posteroventral bristles, none of which are equal in length to breadth of hind femur where situated.

In the female the parafacials and cheeks are more prominent, the former at base of antennae and the latter ventrad of eye margin equal in breadth to length of third antennal segment. Eyes subspherical. Hind femur with or without one or two fine bristles on posteroventral surface. Length, 4.75-5.25 mm.

Records:—1 ♂ 4 ♀ Coaldale, Alta., May 20, 1921; 1 ♀ Lethbridge, Alta., May 30, 1921; 1 ♂ May 20, 1923; (H. L. Seamans); 1 ♂ Cranbrook, B.C., May 17, 1922 (C. B. D. Garrett).

Type, *allotype* and *paratype*, No. 2929 in Canadian National Collection.

***Hylemyia canadensis* sp. nov.**

Male blackish; head with frontal vitta opaque black, tinged with reddish at base of antennae; parafacials and cheeks velvety, silvery pruinose with dark reflections; antennae and palpi blackish; thorax lightly grayish pollinose, subshining, viewed from behind with three narrow vittae, the sublaterals fainter than the median stripe; abdomen more densely grayish pollinose, with dark reflections, viewed from behind with a broad fuscous dorsocentral vitta composed of tergal units that dilate gradually cephalad to merge with the narrow anterior incisures; hypopygium lightly pollinose, subshining. Legs blackish; pulvilli tinged. Wings tinged; veins chocolate brown; calypterae whitish; halteres yellow.

Head with eyes separated at narrowest by a distance not greater than that between posterior ocelli exclusive; frontal vitta distinctly separating parafacials throughout, the latter with four to six pairs of bristles; cruciate setulae weak; parafacials at base of antennae prominent, wider than breadth of third antennal segment, gradually narrowed ventrad, facial margin in profile receding; cheeks as wide as breadth of third antennal segment, marginal bristles in single series, stoutly developed; oral vibrissae separated by a distance greater than length of third antennal segment: antennae with third segment 1.75 times length of second; arista swollen at base, short pubescent, longest hairs about equal in length to diameter at base of arista; palpi narrowly clavate.

Thorax with presutural acrosticals in an irregular closely set series, bristle-like, those postsutural setulose, sparsely set, in an irregularly paired series: post-humeral bristle weakly duplicated; prealar bristle shorter than or nearly equal in length to posterior notopleural bristle; sternopleural bristles, 1 or 2:3. Abdomen narrow, depressed, margins subparallel: hypopygium prominent, processes of fifth sternum with inner margin glossy, polished, with a fringe of short hairs on proximal half, with a series of 8 or 9 short black setae and one or two inwardly directed straight, long, bristles on apical half, outer border with a scattering of bristles and a long straight bristle at apex, cerci with a transverse series of long black bristles, in length not reaching beyond base of fourth sternum.

Fore tibia with a median posteroventral bristle and a sharply pointed apical posteroventral bristle; mid femur with a series of weak anteroventral bristles which gradually become shorter distad, with 5 or 6 long bristles on proximal two-thirds of posteroventral surface, and a weak series on distal third; mid tibia

with or without an anterior bristle, with 1 or 2 anterodorsal, 2 posterodorsal, and 2 posteroventral bristles; hind femur with an entire series of uniform bristles on anteroventral surface, and a series of finer bristles on proximal two-thirds of posteroventral surface, many of the latter being equal in length to breadth of hind femur where situated; hind tibia with 3 to 5 anteroventral, 4 to 5 anterodorsal, 3 posterodorsal bristles, and a median series of posteroventral setulae. Fore claws and pulvilli longer than those on mid and hind legs. Wings with costal thorn prominent; veins R_{4+5} and M_{1+2} subparallel; $m-cu$ cross vein oblique, slightly sinuate; ultimate section of vein M_{1+2} 1.75 times length of penultimate section.

Female lighter in colour than male, frontal vitta reddish cephalad; thorax and abdomen more densely grayish pollinose, the former with a brownish median vitta, the latter unmarked, with a brownish tinge caudad. Wings tinged with yellowish; veins yellowish brown. Fore tibia with a median anterodorsal and posteroventral bristle; mid femur with a strong basal anteroventral bristle and 2 or 3 shortish bristles on proximal half of posteroventral surface; mid tibia with 1 anterior, 1 or 2 anterodorsal, 2 posterodorsal, and 2 posteroventral bristles; hind femur with a series of anteroventral bristles and one or more finer bristles on proximal half of posteroventral surface; hind tibia with 3 or 4 anteroventral, 3 to 5 anterodorsal, and 3 posterodorsal bristles. Costal thorn of wing long, costal setulae semierect. Length, 4.75-6 mm.

Records:—1 ♂ Seven Isles., Quebec, June 22, 1924; 1 ♀ August 9, 1924 (F. W. Waugh); 2 ♂ Banff, Alta., May 5, 1922; 1 ♂ May 27, 1922; 1 ♂ May 29, 1922; 1 ♀ May 30, 1922; 1 ♂ June 8, 1922; 1 ♀ June 16, 1922; 1 ♀ June 18, 1922.

Type, *allotype* and *paratypes*, No. 2930 in Canadian National Collection.

This species may be readily separated from *scamansi*, to which it is allied, by the shorter length of the bristles on cerci of male, the presence of a prealar bristle, the absence of anteroventral bristles on mid tibia, and the presence of posteroventral bristles on hind femur.

***Hylemyia equifrons* sp. nov.**

Male grayish; head with frontal vitta blackish with reddish tinge cephalad; parafrontals and parafacials grayish with whitish pruinescence and reddish reflections; antennae blackish, second segment obscurely brownish toward apical margin; palpi blackish. Thorax with three narrow vittae and brownish infuscation caudad of humeral callosity. Abdomen grayish, with a narrow, indefinite, fuscous vitta; fifth tergum with a darker pruinescence than that of the remaining terga. Legs with femora blackish; tibiae more or less reddish, infuscated, the fore pair almost entirely infuscated. Wings tinged; veins yellowish brown; calyptrae whitish; halteres yellow.

Head with eyes separated by a distance nearly equal to length of antennae; frontal vitta uniformly broad throughout, about equal in breadth to length of third antennal segment; cruciate bristles present; parafrontals with six pairs of bristles which extend caudad to a level with anterior ocellus; cheeks and parafacials at base of antennae about equal in breadth to width of third antennal segment, the parafacials considerably narrowed ventrad; cheeks with marginal bristles in single series, unevenly developed; oral vibrissae long; third antennal segment about 1.75 times length of second segment; arista short pubescent, longest hairs about equal to diameter of basal swelling; palpi slender. Thorax

with one pair of well developed presutural acrosticals, remainder irregularly paired and setulose: prealar bristle shorter than posterior notopleural bristle: sternopleural bristles, 1:3. Abdomen depressed, margins subparallel, but little tapered caudad: hypopygium thickened when viewed in profile: cerci small, with a few well developed apical bristles; processes of fifth sternum with no hairs nor setae on inner margin, inner border and outer surface with scattered setae and bristles which become stronger apicad.

Fore tibia with one median anterodorsal and posteroventral bristle, apical posteroventral bristle strong and sharp pointed; mid femur with four short bristles on proximal half of posteroventral surface; mid tibia with a median anteroventral, 1 anterodorsal, 2 posterodorsal, and 2 posteroventral bristles; hind femur with 4 short bristles on distal half of anteroventral surface, posteroventral surface bare except for apical bristle; hind tibia with 2 anteroventral, 3 anterodorsal, 3 posterodorsal bristles, and a single median posteroventral setula. Tarsi longer than their respective tibiae; pulvilli and claws short. Wings with costal thorn of moderate length; veins R_{4+5} and M_{1+2} slightly convergent at apices; $m-cu$ cross vein sinuate; penultimate section of vein M_{1+2} fully three-quarters as long as ultimate section. Length, 5 mm.

Records:—1 ♂ Banff, Alta., July 10, 1922; 1 ♂ July 23, 1922 (C. B. D. Garrett).

Type, No. 2931 in Canadian National Collection.

The male of this species has the eyes widely separated as in *coenosiaeformis* Stein, and *latifrontalis* Huck. The male may be separated from its closest allies by the following combination of characters, prealar bristle short, mid tibia with a weak median anteroventral bristle, hind femur bare on posteroventral surface, and by the shape of the copulatory appendages.

Hylemyia setisissima sp. nov.

Male grayish; parafacials and cheeks with silvery pruinescence and reddish to blackish reflections; frontal vitta blackish with reddish tinge; antennae blackish, second segment obscurely reddish along apical margin: palpi blackish. Thorax grayish pollinose, with more cinerous tinge on discal area of mesonotum, viewed from behind with three narrow, brownish vittae, macrochaetae set in brownish basal spots. Abdomen more densely grayish pollinose, with dark reflections, viewed from behind with a brownish black dorsocentral vitta which merges at each tergum with the fuscous incisures along their cephalic margin. Legs blackish, knees reddish testaceous, tibiae faintly so: tarsi blackish, pulvilli tinged. Wings faintly tinged, veins light brown; calyptreae whitish; halteres yellow.

Head with eyes separated by a distance less than diameter of anterior ocellus; parafrontals contiguous; frontal vitta reduced; parafrontals with five pairs of bristles; cruciate setulae present; parafacials at base of antennae, when viewed in profile, slightly less than breadth of third antennal segment, narrowed ventrad: cheeks equal to breadth of third antennal segment, marginal bristles in single series; antennae with third segment 1.75 times as long as broad; arista pubescent, longest hairs slightly longer than basal diameter; palpi slender. Thorax with acrosticals in paired series, with a well developed presutural pair, remainder setulose: posthumeral bristles weakly duplicated: prealar bristle shorter than

posterior notopleural bristle: sternopleural bristles, 1:2. Abdomen narrow, depressed, gradually tapered caudad; fourth sternum with bristles erect and noticeably longer and stronger than those on sterna two and three; processes of fifth sternum with long curved bristles on outer surface, resembling those of *pluvialis* Mall., inner border with numerous fine longish setulae, and at apex with two straight, pointed setae; hypopygium prominent; cerci small, with a fringe of longish, curved, outwardly directed bristles.

Fore tibia with a median posteroventral bristle and a strong, blunt, apical posteroventral bristle; mid femur with 3 or 4 weak bristles on basal third of anteroventral surface, and 4 strong bristles on proximal half of posteroventral surface; mid tibia with 1 anterodorsal, 2 posterodorsal, and 2 posteroventral bristles; hind femur with a complete series of anteroventral bristles, and a series of weaker bristles on proximal two-thirds of posteroventral surface; hind tibia with 2 anteroventral, 3 anterodorsal, 3 posterodorsal bristles, and 1 posteroventral seta. Fore pulvilli longer than those of mid and hind legs. Wings slightly pointed, costal thorn moderately developed, veins R_{4+5} and M_{1+2} convergent at apices, *m-cu* cross vein slightly sinuate.

Female grayish: parafacials with grayish pruinescence and reddish reflections; frontal vitta infuscated on caudal half, reddish yellow cephalad. Thorax with five brownish vittae, the two outer not so well defined as the inner three. Abdomen with a fuscous dorsocentral vitta and traces of marginal incisions on each tergum when viewed from behind. Femora blackish, except at apices, which, with the tibiae, are reddish testaceous. Ovipositor with a series of black recurved spines along caudal margin of suranal plate and on outer surface of cerci. Fore tibia with 1 median anterodorsal, and 1 median posteroventral bristle; mid femur with anteroventral surface bare, with two short bristles on proximal third of posteroventral surface; mid tibia with 1 median anteroventral, 1 stout longish anterodorsal, and occasionally a second smaller bristle, 2 short posterodorsal, and 2 short posteroventral bristles; hind femur with 3 or 4 bristles on apical half of anteroventral surface, posteroventral surface bare except for apical bristle; hind tibia with 2 anteroventral, 4 or 5 anterodorsal, and 3 posterodorsal bristles. Otherwise as male except for secondary sexual characters. Length, 5.5 mm.

Records:—1 ♂ Keremeos, B.C., June 21, 1923; 1 ♂ 1 ♀ Hedley, B.C., July 3, 1923; 1 ♀ July 4, 1923; 1 ♂ July 5, 1923; 1 ♀ July 9, 1923 (C. B. D. Garrett).

Type, allotype, and paratype, No. 2932 in Canadian National Collection.

The male of the species may be readily recognized by the pronounced curved bristles on the outer surface of the processes of fifth abdominal sternum, resembling in this respect *pluvialis* Mall., differing however from the male of this species in not having the lateral margins of third abdominal tergum produced ventrad. In the female the ovipositor has recurved spines on the terminal sclerites, the thorax has five vittae, and the mid tibia has an anteroventral bristle.

***Hylemyia oppidans* sp. nov.**

Male blackish; head with frontal vitta reddish cephalad; parafacials and cheeks cinerous pruinose with reddish reflections; antennae and palpi blackish; thorax cinerous pollinose, with three faint vittae; abdomen more densely brown-

ish pollinose with dark reflections, viewed from behind with a well defined linear dorsocentral vitta. Legs with femora almost entirely blackish, tibiae paler, reddish testaceous, more or less infuscated. Tarsi tinged. Wings faintly tinged; halteres and margin of calyptae deep yellow. Head small; eyes separated at narrowest by a distance about equal to diameter of anterior ocellus: frontal vitta entire throughout, expanding broadly cephalad; parafrontals with 6 or 7 pairs of bristles; cruciate setulae present; cheeks and parafacials at base of antennae distinctly broader than width of third antennal segment: parafacials narrowed ventrad: cheeks restricted caudad by invasion of setulae, marginal bristles in single series; antennae short, second segment as long as its breadth along apical margin, third segment about 1.75 times as long as broad, arista minutely pubescent, narrowly thickened basad; palpi clavate. Thorax with acrosticals in an irregular single series; prealar bristle absent; sternopleural bristles, 2:3. Abdomen elongate, depressed: hypopygium small, processes of fifth sternum with long curved bristles along outer surface, and with numerous long, fine setae along inner border.

Fore tibia with 1 median anteroventral bristle, and a strong curved, blunt apical posteroventral bristle; mid femur with a double series of weak anteroventral bristles, with two stout basal bristles and a series of weak posteroventral bristles: mid tibia with 2 short posteroventral bristles: hind femur with a series of 9 or 10 anteroventral bristles, with posteroventral surface bare except for apical bristles; hind tibia with 2 anteroventral, 3 anterodorsal, and 3 posterodorsal bristles, posteroventral surface with a median series of setulae. Mid tarsus shorter than mid tibia, mid metatarsus with a few longish semierect bristles on dorsai surface. Wings with costal thorn small; veins R_{4+5} and M_{1+2} subparallel; *m-cu* cross vein nearly straight.

Female paler than male, otherwise similar; head with frontal vitta reddish; parafacials and cheeks with reddish reflections; second antennal segment obscurely reddish along apical margin. Thorax with distinct median vitta and obscure sublaterals. Abdomen with dark reflections and an indefinite fuscous dorsocentral marking. Color of legs as in male.

Head with cruciate bristles present. Thorax with acrosticals irregular and sparsely set; prealar bristle short. Abdomen with caudal sclerites of ovipositor setulose.

Fore tibia with a median anterodorsal and posteroventral bristle; mid femur with 2 basal anteroventral, and 2 or 3 basal posteroventral bristles: mid tibia with a median anteroventral, 1 strong anterodorsal, 1 posterodorsal and 2 posteroventral bristles; hind femur with 5 or 6 anteroventral bristles, posteroventral surface bare except for apical bristles; hind tibia with 2 anteroventral, 3 or 4 anterodorsal, 3 posterodorsal bristles, and a median posteroventral setula. Pulvilli short. Wings with costal thorns of moderate length; veins R_{4+5} and M_{1+2} subparallel; *m-cu* cross vein slightly sinuate. Length, 6 mm.

Records:—1 ♂ 1 ♀ Royal Oak, B.C., Aug. 18, 1917; 2 ♀ Victoria, B.C., Sept. 6, 1918 (W. Downes).

Type and *Allotype*, No. 2033 in Canadian National Collection.

The processes of fifth sternum of male possess long curved bristles as in *setisissima* and *pluvialis* Mall. From the former the male may be separated by the absence of prealar bristle, the uniserial arrangement of acrostical bristles,

and by the lack of bristles on posteroventral surface of hind femur; from the latter, by the presence of a blunt apical posteroventral bristle on fore tibia, and by the normal structure of third abdominal tergum. The female may be separated from that of *setisissima* and *pluvialis* by the possession of one or two basal bristles on anteroventral surface of mid femur, and, further, from the former, by having the caudal sclerites of ovipositor setulose and not spinose, and from the latter, by the presence of a short prealar bristle and nearly bare arista.

***Hylemyia abitibiensis* sp. nov.**

Male blackish; head with frontal vitta reddish, more or less blackened caudad; parafacials and cheeks silvery pruinose with reddish reflections; antennae and palpi entirely blackish. Thorax lightly grayish pollinose, with black reflections, viewed from behind, with a broad median vitta and narrower, less intensively marked sublaterals, lateral areas of disc caudad of transverse suture suffused with blackish infuscation; scutellum blackish. Abdomen grayish pollinose, with a blackish dorsocentral vitta which merges caudad and cephalad into the narrow tergal incisures. Legs blackish; pulvilli tinged. Wings clear, veins light brownish. Calyptrae whitish with brownish margin; halteres yellow.

Head with eyes separated at narrowest by a distance equal to that between posterior ocelli; frontal vitta completely separates the parafrontals, expanding gradually cephalad: parafrontals with six or seven pairs of weak bristles, cruciate setulae present; parafacials at base of antennae fully equal in breadth to that of third antennal segment, slightly narrowed ventrad; cheeks about equal to breadth of third antennal segment, narrowed caudad, marginal bristles weakly developed, in irregular series, invading the cheeks cephalad where they are upturned: antennae noticeably separated at base by facial elevation, third segment about 1.5 times as long as wide; arista swollen at base, minutely pubescent; palpi short, in length about equal to distance between oral vibrissae; oral margin moderately produced; proboscis slender. Thorax with patches of longish setulae on posthumeral and postsutural areas: acrosticals sparsely set, with three presutural pairs: prealar bristle slightly shorter than posterior notopleural bristle: sternopleural bristles, 1:2. Abdomen depressed, broadly conical; processes of fifth sternum tapering apicad, with a series of fine hairs on inner border, and a few short scattered bristles on outer surface.

Fore tibia with a fine median posterior and posteroventral bristle, apical posteroventral bristle sharply pointed: mid femur with a series of short, fine, anteroventral bristles which become much smaller distad, with a series of 7 or 8 fine bristles on proximal half of posteroventral surface; mid tibia with 1 antero-dorsal, 2 posterodorsal, and 2 posteroventral bristles; hind femur with a complete series of anteroventral bristles, and 7 or 8 fine bristles on proximal two-thirds of posteroventral surface; hind tibia with 3 anteroventral, 5 or 6 short anterodorsal, 3 or 4 posterodorsal bristles, and a median series of posteroventral setulae. Wings with costal thorn minute: veins R_{4+5} and M_{1+2} subparallel: *m-cu* cross vein nearly straight. Length, 5 mm.

Records:—1 ♂ Low Bush, Lake Abitibi, Ont., June 4, 1925 (N. K. Bigelow).

Type No. 2934 in Canadian National Collection.

The male of this species closely resembles that of *trivittata* Stein. It dif-

fers essentially in having no dense series of hairs on inner border of processes of fifth abdominal sternum; the antennae are noticeably separated at base by a facial elevation, the arista is at most very minutely pubescent, the palpi are short.

(To be continued)

BOOK NOTICE.

The Problems of Applied Entomology. By R. A. Wardle, University of Manitoba; xi & 587 pp. & 31 figs. McGraw-Hill Book Company, New York. Price \$4.00.

This volume discusses in a concise and practical manner the various problems of Applied Entomology. It is divided into three parts: in Part I. general problems are treated in ten chapters entitled Host Resistance, Climatic Resistance, Tropic Behaviour, Disease, Parasites and Predators, Theory of Insecticides, Stomach Poisons, Contact Insecticides, Fumigants and Combination Insecticides, and Cultural Influence. Part II., entitled Area Problems, breaks new ground in a brief attempt to outline the major problems of the various countries of the world, whilst Part III provides a very useful bibliography arranged under headings corresponding to the chapters of the preceding parts.

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